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Employment Patterns and Job Satisfaction of Foreign-Born Science and Engineering Doctorate Recipients in the United States

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Science and engineering fields are important to a nation's economy, especially in the areas of innovation and technology development (Committee on Science, Engineering, and Public Policy, 2007). The demand for scientists and engineers is increasing globally, making it more difficult for organizations to attract and retain qualified professionals in these fields as schools and industries compete on a global level for top talent (Committee on Science, Engineering, and Public Policy, 2005). It is not surprising, then, that academia and industry are increasing their focus on the science and engineering workforce. Indeed, a recent National Academies report stated that "identifying the best, brightest, and the most innovative science and engineering talent will be crucial" to maintaining a competitive advantage (Committee on Maximizing the Potential of Women in Academic Science and Engineering, 2006, p. 1-1).

Foreign-born workers comprise a growing share of science and engineering workforce in the United States (e.g., Gurcak, Espenshade, Sparrow, & Paskoff, 2001; Johnson & Regets, 1998; National Science Foundation, 2006). This rapid increase in foreign-born workforce in the U.S. is largely accounted for by global higher education developments, such as the emergence of an international labor market, the ease of workforce mobility, and more importantly, a large number of international students who study in the U.S. (e.g., Altbach, 2003, 2005; Organization for Economic Co-operation and Development, 2002). American universities have always been a popular destination for thousands of students all around the world (Altbach, 2003, 2005; NAFSA, 2006). During the academic year of 2006-2007, there were 582,984 international students enrolled in U.S. higher education institutions, an increase of 3.2% from the previous year (Open Doors 2007: International Students in the United States). Research also indicates that international students earn a growing share of the doctoral degrees awarded by U.S. universities. According to the 2005 report of Survey of Earned Doctorates (SED), of the total of 43,354 doctorate recipients in 2005, 14,424 (33%) were non-U.S. citizens with permanent or temporary visas (Hoffer et al., 2005). SED 2005 report indicates that doctoral degrees awarded to foreign-born students have accounted for almost all of the growth in doctorate recipients since 1975 (Hoffer et al., 2005).

Furthermore, the increase in the number of foreign-born doctoral students is the most noticeable in science and engineering fields. According to 2006 Science and Engineering Indicators, in 2003, 40% of all doctorate degree holders in science and engineering occupations in the U.S. were foreign-born (National Science Foundation, 2006). Moreover, foreign-born individuals comprised more than half of all doctorate recipients in the fields of computer science (57%), electrical engineering (57%), civil engineering (54%), and mechanical engineering (52%) (National Science Foundation, 2006).

Increases in the number of international students who earn their doctoral degrees in the U.S. contribute significantly to the growth of foreign-born workforce in the country. Many foreign-born workers come to the United States as graduate students and after completing their doctoral degrees choose to join the U.S. workforce. Research indicates that, traditionally, a significant number of international students who obtain their doctoral degrees abroad do not return home (Altbach, 2003, 2005). For example, two-thirds (66 %) of foreign citizens who received science and engineering doctorates from U.S. universities in 2003 were still in the country in 2005 (Finn, 2007). Hoffer et al. (2005) also indicate that

the tendency for non-U.S. citizens on temporary visas to remain in the U.S. after graduation has increased over time. In 1985, about half (51%) of foreign-born graduates with temporary visas had plans to stay in the U.S. after graduation, while in 2005, the number had increased to 74% (Hoffer et al., 2005). Furthermore, chemistry, biological sciences, and electrical engineering fields had the highest numbers of new doctorate recipients with temporary visas staying in the U.S. (90%, 89%, and 84%, respectively) (Hoffer et al., 2005).

Thus, the growth in the number of foreign-born doctorate recipients has had a profound impact on the racial and ethnic composition of the American workforce. These trends have created a vibrant group of foreign-born workforce on whom both academic institutions and industries have come to rely. However, despite the increasing numbers and significance of foreign-born science and engineering doctorate recipients in the U.S., there has been limited research in higher education literature that examined work attitudes and experiences of this group of individuals. The current study intends to address, in part, this gap in the literature.

The purpose of this study is to identify the demographic characteristics, employment patterns, and job satisfaction issues of foreign-born science and engineering doctoral graduates. In particular, the study focuses on foreign-born scientists and engineers who are employed in business/industry or academic sectors. Identifying the demographic characteristics of this group as well as possible job satisfaction issues will help employers to attract and retain this important group of employees.

Literature Review

The rapid growth of foreign-born workforce has evoked a greater interest in the work life of these highly skilled professionals who are increasingly being employed by U.S. academic institutions and business industries. Research that has emerged as part of a larger body of literature exploring the dynamics of high-skill immigration has focused primarily on the importance and the contribution of foreign-born workers, especially, foreign-born scientists and engineers, to the U.S. economy (Johnson & Regents, 1998; Levin & Stephen, 1999; Mosisa, 2002; Organization for Economic Co-operation and Development, 2002). In addition, within the body of faculty work life studies, there has been a growing body of literature concerning the work life issues of the foreign-born subgroup of the professoriate in the U.S. (Corley & Sabharwal, 2007; Manrique & Manrique, 1999; Marvasti, 2005; Skachkova, 2007; Thomas & Johnson, 2004; Wells, Seifert, Park, Reed, & Umbach, 2007).

Two most recent studies are particularly noteworthy (Corley & Sabharwal, 2007; Wells et al., 2007). The study by Wells et al. (2007) examined the differences in job satisfaction between foreign-born faculty members, based on their geographic region of origin, and their American colleagues. Drawing on the data from NSOPF:99, the study found that at least two groups of international faculty members were less satisfied with their jobs. More specifically, on the measures of satisfaction with autonomy and contractual issues, Middle Easterners and Asians were less satisfied than their citizen colleagues. The study also revealed that there were differences among international faculty members based on their region of origin, which indicated that international faculty members were not a homogenous group. For example, being Middle-Eastern affected job satisfaction more for autonomy and being Asian negatively affected job satisfaction more for contract-related issues (Wells et al., 2007).

Another study by Corley and Sabharwal (2007) of foreign-born academic scientists, which is particularly relevant to this study, compared productivity levels, work satisfaction, and career trajectories of foreign-born and U.S.-born scientists. Using the 2001 Survey of Doctorate Recipients (SDR), Corley and Sabharwal (2007) found that foreign-born scientists were more productive in research than their U.S.-born peers in all measures of scholarly productivity used in the study (i.e., number of articles published, number of books or monographs, number of papers presented at a

regional, national, or international conferences, and number of patents). I
n addition, the study concluded that despite higher productivity, salary levels and job satisfaction of foreign-born academic scientists were lower than U.S.-born scientists (Corley & Sabharwal, 2007).
In sum, this overview of the literature indicates that there has been a growing interest in the foreign-born workforce in the United States. Yet, our understanding of the work life and satisfaction of foreign-born scientists and engineers is still very limited, especially of those who are employed outside academia. The study intends to help address this gap in the literature and examine at a national level the demographic and employment characteristics and job satisfaction of the foreign-born doctorate recipients in science and engineering fields, employed both in academia and industry.

Conceptual Framework

Job satisfaction has been of continual interest for numerous researchers in industrial and organizational psychology, economics, and sociology. Content and process theories are two main theoretical frameworks commonly used by researchers to examine the concept of job satisfaction. Content theorists explain satisfaction in terms of needs that must be fulfilled in order for workers to be satisfied (Herzberg, Mausner, & Snyderman, 1959). For example, a “two-factor” theory developed by Herzberg, Mausner, and Snyderman (1959) relates job satisfaction to motivators or intrinsic aspects of the job and dissatisfaction to hygienes or extrinsic and contextual factors.
As opposed to content theories, process or discrepancy theories explain satisfaction in terms of the degree of similarity between what a worker values or desires and what the workplace provides (Locke, 1976, 1984). In other words, process theorists argue that, while needs are the starting point for employees’ emotional responses, “the individual’s values – their consciously or subconsciously acquired conceptions of what is good, desirable or beneficial – are what most immediately govern their choices, actions and emotions” (Locke, Fitzpatrick, & White, 1983, p. 344).
Values are of crucial importance in Locke’s theory. Locke (1976) defines job satisfaction as a positive emotional response to the job resulting “from an appraisal of one’s job as attaining or allowing the attainment of one’s important job values, providing these values are congruent with or help to fulfill one’s basic needs” (p. 1319). His definition of job satisfaction suggests that people evaluate job characteristics differently and seek different outcomes from their work. Based on this view, satisfaction results if employees get what they value or desire from their jobs.
Following this argument, one can assume that a good fit between what the worker values and what the job provides will lead to job satisfaction. According to Hall (1994), “the worker must ‘fit’ with the environment and vice versa for job satisfaction to result” (p. 102). Fit hypothesis can be a useful tool in examining job satisfaction. That said, one can expect that people who value autonomy, flexibility, and job security over additional earnings would more likely be satisfied to work in academia (Bender & Heywood, 2006). For example, in their study of job satisfaction of scientists and engineers in the United States, Bender and Heywood (2006) found that academic scientists with tenure had substantially greater satisfaction than nonacademic scientists.
Fit hypothesis can be also helpful in examining the relationship between job satisfaction and employees’ demographic characteristics, such as gender, age, and race/ethnicity (Hall, 1994, p. 102). For example, men and women bring different expectations and values to their jobs and receive job satisfaction from different job conditions. Studies indicate that women are significantly more satisfied with their jobs than men despite their objectively poorer jobs and greater difficulties with balancing work and family responsibilities (Clark, 1997). Hall (1994) notes that this finding is consistent with the fit hypothesis. Women’s higher satisfaction level is often explained by the fact that women, compared to

men, have lower expectations of the benefits they could receive from the labor market (Clark, 1997). Research also shows that younger workers are consistently less satisfied with their jobs than older workers (Hall, 1994; Schultz, 1973). Younger workers might have objectively poorer jobs than older employees, but they also have higher expectations for their jobs that may lead to lower job satisfaction (Hall, 1994). Similar to gender and age differences in job satisfaction, there are also differences in job satisfaction across countries (Kirkman & Shapiro, 2001; Spector, 1997). The differences are attributed, in part, to different expectations and values of employees (Kirkman & Shapiro, 2001; Spector, 1997). Whereas there are differences in job satisfaction across countries, the same cannot be said of studies focused on differences among races in the U.S. (Spector, 1997). Indeed, research results have been inconsistent in their findings of job satisfaction differences by race (Spector, 1997; Friday, Moss, & Friday, 2004). Researchers are especially cautious when examining and interpreting differences in job satisfaction by race for foreign-born individuals in the U.S. According to Wells et al. (2007), race, as a socially constructed concept, means "different things across national borders, and it may not accurately reflect cultural differences" (p. 27). Some researchers suggest that it is more appropriate to use geographic region of origin, rather than race, when examining the job satisfaction of foreign-born workforce in the U.S. (Wells et al., 2007).

This study intends to contribute to this existing research by examining job satisfaction of one of the most highly skilled group of professionals in the United States. As noted above, foreign-born scientists and engineers are a vital source for the country's vibrant economy, and the research conducted here makes a very modest contribution to understanding work experiences and attitudes of this important group of professionals.

Methods

Data Source, Sample, and Variables

The study utilizes the 2003 Survey of Doctorate Recipients (SDR03) sponsored by the National Science Foundation (NSF) and other U.S. federal agencies. The Survey of Doctorate Recipients comprises information about the employment, educational, and demographic characteristics of science and engineering doctorate holders in the U.S. (SESTAT: Scientists and Engineers Statistical Data System, 2007). In this survey, science and engineering doctorate degree recipients are followed throughout their careers from year of degree award until the age of 75 (SESTAT, 2007). The 2003 data set includes the total of 29,915 science and engineering Ph.D. holders in the U.S. who had earned their doctorates through the 2001 academic year.

The sample for this study includes 5,476 foreign-born science and engineering degree-recipients from SDR03 data set who are employed in academia and industry. The study excludes those foreign-born degree recipients who are currently not in labor force or employed in the government sector. Out of these 5,476 foreign-born doctorate recipients, 2,328 (42.5%) are non-citizens of the U.S. and 3,148 (57.5%) are naturalized citizens who were born abroad. There are 1,692 (30.9%) females and 3,784 (69.1%) males in our sample. The majority of foreign-born science and engineering doctorate recipients (55.5%) are Asian, while 32.8% are Whites and another 11.7% include other under-represented minorities. A little more than half (52.3%) are employed in the business sector, as compared to 47.7% who work in academic institutions.

The study utilizes appropriate sampling weights to make these data representative of the population. First, to correct for oversampling, the raw weights provided in the data set are transformed into relati ve weights by dividing the raw weight by its mean (Thomas & Heck, 2001). Second, to correct for clustering of observations and to obtain more accurate estimates, the study evaluates each parameter in terms of a more conservative alpha value (i.e., .001 instead of .01 and .05) (Thomas & Heck, 2001).

This study views satisfaction as “a unitary concept” (Hall, 1994, p. 100). The researchers recognize that job satisfaction is a complex set of attitudes and emotions toward various aspects of the work (Kalleberg, 1977; Spector, 1997). However, some researchers believe that the view of job satisfaction as a unitary concept could be advantageous because “this recognizes the fact that work is multifaceted and yet experienced as a whole” (Hall, 1994, p. 100). Building on this argument, this study measures job satisfaction based on the single question that asks the respondents to rate the overall satisfaction with the job. The respondents are given four choices to indicate the level of their overall job satisfaction: 1 = Very Dissatisfied, 2 = Somewhat Dissatisfied, 3 = Somewhat Satisfied, and 4 = Very Satisfied. It should also be noted that job satisfaction variables, especially when measured by a single variable, have little variance, because a large majority of people surveyed usually indicate that they are satisfied with their jobs (Hall, 1994). Little variance in job satisfaction variables presents one of the major limitations of job satisfaction studies.

The use of secondary data is another major limitation of the study. The limited choice of publicly accessible variables within SDR data set restricts the researchers to include potentially important variables and permits only the descriptive analysis of the available data. The researchers acknowledge that the limited choice of the variables is the major limitation for this research, but they believe that the descriptive study conducted here can still offer interesting findings regarding this important group of highly skilled professionals in the American workforce.

Data Analysis

Data analysis in this study consisted of the following steps. First, the researchers generated a subset data set from the original SDR03 database. This subset data set included only foreign-born science and engineering doctorate recipients in the U.S. who were employed in academic institutions or business/industry sector. Second, the researchers examined frequencies and percentages to provide a demographic and employment profile of these individuals. Finally, the researchers conducted Independent Samples t-tests and Analyses of Variance (ANOVAs) in the aggregate as well as within each sector type (i.e., academia and industry/business) to examine the mean differences in the respondents’ job satisfaction by their demographic characteristics, including gender, age, race/ethnicity, and citizenship status.

Results

The examination of demographic and employment characteristics of foreign-born science and engineering doctoral graduates in the U.S. reveals some interesting trends (Table 1 presents the demographic characteristics of foreign-born scientists and engineers in the aggregate as well as within each sector type). Out of 5,476 foreign-born doctorate recipients in our sample, 2,865 (52.3%) work in the business sector and 2,611 (47.7%) are employed in academic institutions. The data suggest that women are more likely to work in academia than in industry. Out of 1,692 females in the sample, 972 work in the academic sector and 720 work in the business sector. The data also suggest that Asians are more likely to be employed in the business sector than in academia. Out of 3,040 Asians in our sample, 1,850 of them are employed in industry compared to only 1,190 who work in academia. On the other hand, whites and under-represented minorities are more likely to be employed in academic institutions. In our sample, 1,010 Whites and 411 under-represented minorities work in academia compared with only 788 Whites and 227 under-represented minorities who are employed in the business sector. The data also reveal that younger age groups tend to be employed in larger numbers in the business sector than in academia. In our sample, 2,155 individuals who were born in 1955 or after are employed in the industry, as compared with only 1,770 foreign-born individuals from the same

age groups who work in academia.

In the aggregate level, the results from Independent Samples t-tests (Table 2) indicated that there was a significant difference in the level of job satisfaction by sector, t(5474) = 18.79, p <.001. Foreign-born doctorate recipients employed in the academic sector (M = 3.32, SD = .68) were significantly more satisfied than their counterparts from the business sector (M = 3.20, SD = .68).

Table 1

Foreign-Born Science and Engineering Doctorate Recipients' Demographic Characteristics

	Aggregate	*Academic Sector*	*Business Sector*
Gender			
Male	3784 (69.1%)	1639 (62.8%)	2145 (74.9%)
Female	1692 (30.9%)	972 (37.2%)	720 (25.1%)
Race/Ethnicity			
Asians	3040 (55.5%)	1190 (45.6%)	1850 (64.6%)
Whites	1798 (32.8%)	1010 (38.7%)	788 (27.5%)
Under-Represented Minorities	638 (11.7%)	411 (15.7%)	227 (7.9%)
Citizenship Status			
Naturalized Citizens	3148 (57.5%)	1457 (55.8%)	1691 (59.0%)
Non-Citizens	2328 (42.5%)	1154 (44.2%)	1174 (41.0%)
Age Groups [a]			
Generation Y: Born 1965 and after	1677 (30.6%)	749 (28.7%)	928 (32.4%)
Generation Jones: Born 1955-1964	2248 (41.1%)	1021 (39.1%)	1227 (42.8%)
Baby Boomers: Born 1945-1954	859 (15.7%)	447 (17.1%)	412 (14.4%)
Born 1944 or earlier	692 (12.6%)	394 (15.1%)	298 (10.4%)

Note. [a] Age groups were coded based on the respondents' age in 2003.

In the aggregate, the results from the Analyses of Variance (Table 2) revealed that that the effect of race/ethnicity on job satisfaction was significant, F(2, 5473) = 27.874, p < .001. Post hoc analyses using Tukey tests indicated that Asians (M = 3.20, SD = .68) were significantly less satisfied than both Whites (M = 3.34, SD = .68) and other under-represented minorities (M = 3.32, SD = .70). There was also a significant difference in job satisfaction by age groups F(3, 5472) = 32.077, p < .001. The data showed that older cohorts were significantly more satisfied than younger age groups.

When job satisfaction was examined by the sector type for each demographic group of foreign-born scientists and engineers in the study, the analysis showed that all gender, age, and ethnic groups had higher satisfaction levels in academia than in industry (Table 3).

Table 2

Job Satisfaction of Foreign-Born Science and Engineering Doctorate Recipients in the U.S.

Source	*N*	*Mean*	*SD*	*F Values*
Sector				
Academic Sector	2611	3.32	.68	18.79***
Business Sector	2865	3.20	.68	
Gender				
Female	1692	3.26	.68	.033
Male	3784	3.26	.69	
Citizenship Status				
Naturalized Citizens	3148	3.29	.68	4.883
Non-Citizens	2328	3.21	.69	
Race/Ethnicity [a]				
Asians	3040	3.20	.63	27.874***
Whites	1798	3.34	.68	
Under-Represented Minorities	638	3.31	.70	

Desegregating the data by sector type reveals very similar findings (Table 4). When the same analyses were conducted separately within the academic or business sector, the data

showed that there was a significant difference in job satisfaction between White and Asian doctorate recipients. On the other hand, there were no significant differences found between other under-represented minorities and Whites or Asians. The baby boomers or the cohort born in 1944 or earlier were also significantly more satisfied than younger age groups. The study failed to find any significant effect of gender on job satisfaction, neither in the aggregate nor within each sector level.

Discussion of Results

The examination of demographic characteristics of our sample indicates that more than half of all foreign-born scientists and engineers in the U.S. (55.5%) come from Asian countries. This ethnic composition of foreign-born scientists and engineers could be attributed to the considerable growth in the number of international students from Asia. According to Gurcak et al. (2001), U.S. colleges and universities educate one-forth of all Asian Ph.D. recipients. Hoffer et al. (2005) also indicate that, according to SED, the leading four countries in terms of the number of doctorates awarded to its citizens are Asian countries (China, Korea, India, and Taiwan, respectively).

Age Groups [b]				
Generation Y: Born 1965 and after	1677	3.22	.69	32.077***
Generation Jones: Born 1955-1964	2248	3.21	.67	
Baby Boomers: Born 1945-1954	859	3.30	.71	
Born 1944 or earlier	692	3.48	.63	

Note. ***$p < .001$.

Job Satisfaction was coded as 1 = very dissatisfied, 2 = somewhat dissatisfied, 3 = somewhat satisfied, 4 = very satisfied.

[a] Asians were significantly less satisfied than both Whites and other under-represented minorities.

[b] Age groups were coded based on the respondents' age in 2003. The age group born 1944 or earlier and Baby Boomers were significantly more satisfied than younger cohorts.

Table 3

Foreign-Born Science and Engineering Doctorate Recipients' Job Satisfaction by the Employment Sector and Demographics

	Academic Sector Mean (SD)	*Business Sector Mean (SD)*
Gender		
Female	3.31 (.68)***	3.19 (.68)***
Male	3.33 (.68)***	3.20 (.68)***
Race/Ethnicity		
Asians	3.26 (.68)***	3.16 (.67)***
Whites	3.39 (.68)***	3.28 (.68)***
Under-Represented Minorities	3.34 (.67)	3.27 (.73)
Citizenship Status		
Naturalized Citizens	3.36 (.68)***	3.24 (.68)***
Non-Citizens	3.27 (.68)***	3.15 (.69)***
Age Groups [a]		
Generation Y: Born 1965 and after	3.31 (.69)***	3.14 (.68)***
Generation Jones: Born 1955-1964	3.25 (.68)***	3.17 (.66)***
Baby Boomers: Born 1945-1954	3.33 (.69)	3.27 (.73)
Born 1944 or earlier	3.53 (.62)	3.42 (.64)

Note. ***$p < .001$.

[a] Age groups were coded based on the respondents' age in 2003.

Table 4

Job Satisfaction of Foreign-Born Science and Engineering Doctorate Recipients in the Academic and Industry Sectors

Source	*Academic Sector*		*Non-Academic Sector*	
	Mean (SD)	*F Values*	*Mean (SD)*	*F Values*
Gender				
Female	3.31 (.68)	.012	3.19 (.68)	.435
Male	3.33 (.68)		3.20 (.68)	
Citizenship Status				
Naturalized Citizens	3.36 (.68)	1.451	3.24 (.68)	4.006***
Non-Citizens	3.27 (.68)		3.15 (.69)	
Race/Ethnicity [a]				
Asians	3.26 (.68)	10.889***	3.16 (.67)	9.634***
Whites	3.39 (.68)		3.28 (.68)	
Under-Represented Minorities	3.34 (.67)		3.27 (.73)	
Age Groups [b]				
Generation Y: Born 1965 and after	3.31 (.69)	16.052***	3.14 (.68)	14.673***

Generation Jones: Born 1955-1964	3.25 (.68)		3.17 (.66)	
Baby Boomers: Born 1945-1954	3.32 (.69)		3.27 (.73)	
Born 1944 or earlier	3.53 (.62)		3.42 (.64)	

Note. ***$p < .001$.
Job Satisfaction was coded as 1 = very dissatisfied, 2 = somewhat dissatisfied, 3 = somewhat satisfied, 4 = very satisfied.
[a] Asians were significantly less satisfied than Whites.
[b] Age groups were coded based on the respondents' age in 2003. The age group born 1944 or earlier and Baby Boomers were significantly more satisfied than younger cohorts.

The examination of the demographic composition of our sample also reveals that less than third (30.9%) of the foreign-born scientists and engineers are female. Sciences and engineering are still very male-dominated fields, despite the fact that the number of women earning their science degrees at the undergraduate and graduate levels is continually increasing (National Science Foundation, 2006). Under-representation of women in sciences and engineering workforce could be even more evident among foreign-born scientists and engineers. Past research suggested that there was a higher representation of women among native-born than foreign-born scientists and engineers (e.g., North, 1995). However, Survey of Earned Doctorates from 2005 indicates that non-citizen women were more concentrated in the S&E fields than female U.S. citizens (Hoffer et al., 2005). While international female students earned 21% of all female doctorate recipients in 2005, they earned 25% of the doctorates received in life sciences, 39% of the doctorates earned by females in physical sciences, and 54% of the doctorates earned by females in engineering (Hoffer et al., 2005). These trends could suggest that while more foreign-born women are entering science, there could be a higher attrition of foreign-born women during their careers or they might simply be returning to their home countries in larger numbers than males.

The data from the study also suggested that foreign-born females are more likely to be employed in academia than in industry. This finding is consistent with the previous studies that indicate that women are more likely to work in academic institutions, because academic sector provides a greater ability for them to trade-off income for flexible working hours (Bender, Donohue, & Heywood, 2005; Bender & Heywood, 2006). The study also showed that Asians are more likely to work in the business sector than Whites and other under-represented minorities. This finding is consistent with SED data from 2005 that also suggest that Asians were the most likely to choose industry or self-employment over working in the academy (Hoffer et al., 2005).

Overall, foreign-born scientists and engineers in our sample seemed to be more satisfied with their jobs in academia than in the business sector. This finding is consistent with the previous study conducted by Bender and Heywood (2006) that examined the job satisfaction of Ph.D.-level scientists in the U.S. based on the analysis of data from the 1997 Survey of S&E Doctorate Recipients. Moreover, as noted earlier, all gender, racial/ethnic, and age groups in this study, except under-represented minorities, baby boomers, and cohorts born 1944 or earlier, were significantly more satisfied in academia than in industry (Table 3). Despite the fact that the business sector may offer more financial rewards to its employees, we could suppose that foreign-born scientists and engineers find better job security and professional fit in the academy that in turn translate into their greater job satisfaction. Indeed, Bender and Heywood (2006) suggested that relatively high satisfaction of academics in science and engineering fields compared to non-academics was attributed to the convention of tenure in the academy. They found that once controlling for tenure and holding earnings constant, academics with tenure reported considerably greater job satisfaction than their counterparts in the business sector, while academics without tenure had similar job satisfaction as those outside academia.

The effect of age on job satisfaction in our study was also consistent with the previous research (Hall,

1994; Schultz, 1973). Younger cohorts of foreign-born Ph.D. scientists and engineers were less satisfied than the older age groups, because as previous research suggests younger workers might not only have objectively poorer jobs but also higher expectations that lead to their job dissatisfaction (Hall, 1994). When examining the effects of race/ethnicity on job satisfaction, the study found Asians to be less satisfied compared to Whites and other under-represented minorities. Previous research is inconclusive in showing that there are racial/ethnic differences in job satisfaction (Spector, 1997; Friday, Moss, & Friday, 2004). There might be other factors that are confounding this relationship, which are not examined in this analysis. As noted earlier, it would have been more appropriate to use region or country of origin to examine the job satisfaction of foreign-born workforce in this study. However, due to a data limitation (SDR does not include the variable about country of origin), the researcher had to use the race variable instead, which might have masked the differences in job satisfaction across different ethnic groups within our sample.

Surprisingly, the analysis did not find any significant effect of gender on the job satisfaction of foreign-born scientists and engineers, neither in the aggregate nor within each sector type. This finding is contrary to the findings from the previous job satisfaction studies of female scientists and engineers in the U.S. that found significant relationships between gender and job satisfaction (Callister, 2006; Settles, Cortina, Malley, & Stewart, 2006). However, previous research also indicates that there are other variables that mediate gender-satisfaction relationship that were not tested in our analysis due to the limited range of variables available in our data set. For example, Callister (2006) found that while gender influenced satisfaction of faculty members in science and engineering fields (female faculty reported significantly lower levels of job satisfaction than male faculty members), this relationship was mediated by the department climate. Another study also found that female scientists who viewed department climate as more sexist were significantly less satisfied with their jobs (Settles, Cortina, Malley, & Stewart, 2006). These studies indicate that women scientists might not be inherently dissatisfied or unhappy with their jobs, but rather that negative gender-related experiences, such as gender discrimination, non-supportive departmental climate, sexual harassment, might lead to their job dissatisfaction.

The findings of this study are important to expand our understanding of demographic and employment characteristics and job satisfaction of foreign-born scientists and engineers in the U.S. The study indicated that although bigger shares of foreign-born doctorate recipients from younger cohorts choose industry employment over academia, they still seem to be happier in academic institutions than in industry. Further studies need to be conducted to understand what factors influence their decisions about what career paths to pursue and what aspects of their careers in academia or industry contribute to their job satisfaction.

As the significance and contribution of foreign-born scientists and engineers to a nation's competitive advantage in the world continues to rise, it is important to understand who they are, what they do, and how satisfied they are with their jobs. There is an inherent belief that increased satisfaction is related to enhanced productivity (Gruneberg, 1979; Herzberg, Mausner, & Snyderman, 1959; Judge, Bono, Thoresen, & Patton, 2001; Schultz, 1973; Spector, 1997). Thus, it is beneficial to keep "the best, brightest, and the most innovative science and engineering talent" (Committee on Maximizing the Potential of Women in Academic Science and Engineering, 2006, p. 1-1) satisfied with their jobs, so that they are better able to fully utilize their expertise and pursue their professional goals and commitments more effectively.

References

Altbach, P. G. (2003). Centers and peripheries in the academic profession: The special challenges of developing countries. In P. G. Altbach (Ed.), The decline of the guru: The academic profession in the third world (pp. 1-23). New York: Palgrave.

Altbach, P. G. (2005). Globalization and the university: Myths and realities in an unequal world. The NEA 2005 Almanac of Higher Education, 63-74.

Bender, K. A., & Heywood, J. S. (2006). Job satisfaction of the highly educated: The role of gender, academic tenure, and earnings. Scottish Journal of Political Economy, 53(2), 253-279.

Bender, K. A., Donohue, S. M., & Heywood, J. S. (2005). Job satisfaction and gender segregation. Oxford Economic Paper, 57, 479-496.

Callister, R. R. (2006). The impact of gender and department climate on job satisfaction and intentions to quit for faculty in sciences and engineering fields. Journal of Technology Transfer, 31, 367-375.

Clark, A. E. (1997). Job satisfaction and gender: Why are women so happy at work? Labour Economics, 4, 341-372.

Committee on Maximizing the Potential of Women in Academic Science and Engineering (2006). Beyond bias and barriers: Fulfilling the potential of women in academic science and engineering. Washington, DC: The National Academies Press.

Committee on Science, Engineering, and Public Policy (2005). Policy implications of international graduate students and postdoctoral scholars in the United States. Washington, DC: The National Academies Press.

Committee on Science, Engineering, and Public Policy (2007). Rising above the gathering storm: Energizing and employing America for a brighter economic future. Washington, DC: The National Academies Press.

Finn, M. G. (2007). Stay rates of foreign doctorate recipients from U.S. Universities, 2005. Retrieved July 24, 2008, from Oak Ridge Institute for Science and Education (ORISE) Web site:

http://orise.orau.gov/sep/files/stayrate07.pdf

Friday, S. S., Moss, S. E., & Friday, E. (2004). Socio-ethnic explanations for racio-ethnic differences in job satisfaction. The Journal of Management Development, 23, 152-168.

Gruneberg, M.M. (1979). Understanding job satisfaction. New York: Wiley.

Gurcak, J. C., Espenshade, T. J., Sparrow, A., & Paskoff, M. (2001). Immigration of scientists and engineers to the United States: Issues and Evidence. In W. A. Cornelius, T. J. Espenshade, and I. Salehyan (Eds.), The international migration of the highly skilled: Demand, supply, and development consequences in sending and receiving countries (pp. 55-84). University of California, San Diego: Center for Comparative Immigration Studies.

Hall, R. H. (1994). The individual experience of work. In R. H. Hall (Ed.) Sociology of work: Perspectives, analyses, and issues (pp. 86-123). Thousand Oaks, CA: Pine Forge Press.

Herzberg, F., Mausner, B., & Snyderman, B. B. (1959). The motivation to work (2nd ed.). New York: John Wiley and Sons.

Hoffer, T. B., Welch, V. JR., Webber, K., Williams, K., Lisek, B., Hess, M., Loew, D., & Guzman-Barron, I. (2005). Doctorate recipients from United States universities: Summary report 2005. Chicago: National Opinion Research Center. Retrieved September 13, 2007, from http://www.norc.org/NR/rdonlyres/2E87F80C-82F6-4E26-9F78-CA4C6E0B79C6/0/sed2005.pdf

Johnson, J. M., & Regets, M. C. (1998, June 22). International mobility of scientists and engineers to the United States – brain drain or brain circulation? (Issue Brief No. 98-316). Retrieved February 26, 2006, from National Science Foundation Web site: http://www.nsf.gov/statistics/issuebrf/sib98316.pdf

Judge, T. A., Bono, J. E., Thoresen, C. J., & Patton, G. K. (2001). The job satisfaction-job performance relationship: A qualitative and quantitative review. Psychological Bulletin, 127(3), 376-407.

Kalleberg, A. (1977). Work values and job rewards: A theory of job satisfaction. American Sociological Review, 42(1), 124-143.

Kirman, B. L. & Shapiro, D. L. (2001). The impact of cultural values on job satisfaction and organizational commitment in self-managing work teams: The mediating role of employee resistance. Academy of Management Journal, 44, 557-570.

Levin, S. G., & Stephen, P. E. (1999). Are the foreign born a source of strength for U.S. science? Science, 285(5431), 1-6.

Locke, E. A. (1976). The nature and causes of job satisfaction. In M. D. Dunnette (Ed.), Handbook of industrial and organizational psychology (pp. 1297-1349). New York: John Wiley & Sons.

Locke, E. A. (1984). Job satisfaction. In M. Gruneberg and T. Wall (Eds.), Social psychology and organizational behavior (pp. 93-117). New York: John Wiley & Sons.

Locke, E. A., Fitzpatrick, W., & White, F. M. (1983). Job satisfaction and role clarity among university and college faculty. Review of Higher Education, 6(4), 343-365.

Manrique, C. G., & Manrique, G. G. (1999). The multicultural or immigrant faculty in American society. Lewiston, NY: The Edwin Mellen Press.

Marvasti, A. (2005). U.S. academic institutions and perceived effectiveness of foreign-born faculty. Journal of Economic Issues, 39(1), 151-176.

Mosisa, A. T. (2002). The role of foreign-born workers in the U.S. economy. Monthly Labor Review, 125(5), 3-14.

NAFSA: The Association of International Educators. (2006). Restoring U.S. competitiveness for international students and scholars. Retrieved September 13, 2007, from NAFSA web site: http://www.nafsa.org/_/Document/_/restoring_u.s.pdf

National Science Foundation (2006). Science and Engineering Indicators 2006. Arlington, VA.

Retrieved April 28, 2007, from http://www.nsf.gov/statistics/seind06/toc.htm

North, D. S. (1995). Soothing the establishment: The impact of foreign-born scientists and engineers on America. Lanham, MD: University Press of America.

Organization for Economic Co-operation and Development. (2002). International mobility of the highly skilled. Retrieved April 6, 2006, from OECD Web site: http://www.oecd.org/dataoecd/9/20/1950028.pdf

Schultz, D. (1973). Psychology and industry today. New York, NY: The Macmillan Company.

Scientists and Engineers Statistical Data System (SESTAT) (2007). Research and Methodology Report. Retrieved April 28, 2007, from http://srsstats.sbe.nsf.gov/docs/techinfo.html

Settles, I. H., Cortina, L. M., Malley, J., & Stewart, A. J. (2006). The climate for women in academic science: The good, the bad, and the changeable. Psychology of Women Quarterly, 30, 47-58.

Skachkova, P. (2007). Academic careers of immigrant women professors in the U.S. Higher Education, 53, 697-738.

Spector, P. E. (1997). Job satisfaction: Application, assessment, cause, and consequences. Thousand Oaks, CA: Sage.

Thomas, S. L., & Heck, R. H. (2001). Analysis of large-scale secondary data in higher education research: Potential perils associated with complex sampling designs. Research in Higher Education, 42(5), 517-540.

Thomas, J. M., & Johnson, B. J. (2004). Perspectives of international faculty members: Their experiences and stories. Education and Society, 22(3), 47-64.